Electrical Power and Machines Department

TANTA UNIVERSITY **Faculty Of Engineering**

MID-TERM EXAM 2013/2014

Course	**Energy Conversion** (EPM2106)	**Time**	**60 minutes**
Students	**2nd Year (Electrical Power and Machines)**	**Mark**	**30**

Answer ALL the following questions:

- ***Clarify your answer with the suitable sketches as you can.***
- ***Assume any missed data reasonably.***

The first question (5 marks)

Choose the correct answer/answers for the following statements. It is sufficient to write down the question number followed by your choice/choices in your answer sheet:

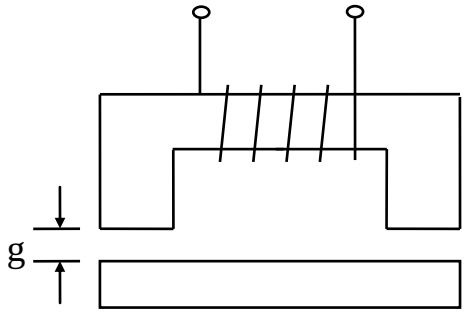
1.	Nonlinear magnetic characteristics leads to: A) distorted magnetizing current C) higher inductance B) higher power loss D) inducing an emf
2.	Two magnetically coupled coils have self inductances of L_{11} and L_{22}. The value of the mutual inductance M *may take a value* which is: A) less than the smaller self inductance C) higher than the larger self inductance B) between values of L11 and L22 D) of any positive value
3.	For mutually coupled coils, if currents are both entering at the dot-marked terminals, coil fluxes A) are additive C) are subtractive B) increase D) cancel each other
4.	For dc excitation, induced emf is A) only speed voltage C) only transformer voltage B) both speed and transformer voltages D) always zero.
5.	A two-phase winding excited from a two-phase gives A) a single rotating mmf C) two rotating mmfs with anti-direction B) stationary mmf D) Pulsating mmf.

The second question (5 marks)

Which of the following statements is correct? You can write down in your answer sheet the question number followed by either √ or X mark.

1.	Core losses depend on area of hysteresis loop of the magnetic material.
2.	Motional (speed) voltage increases with increasing supply frequency
3.	Inductance of a coil increases with increase in magnetic reluctance of its core.
4.	For a linear magnetic system, coil inductance does not depend on its current
5.	Distribution factor is used to eliminate the effect of high field harmonics

The third question (10 marks)	
1.	With the aid of BH curve of a permanent magnet material show: (2 marks) a) the effect of air gap length on the position of the operation point b) the point of maximum energy product
2.	Show the MMF space distribution a dc-excited coil of uniform air gap, if the conductors are : a) concentrated b) distributed in 8 slots (4 in each side). Which of the two cases are preferred? Why? (4 marks)
3.	Define what is meant by transformer and rotational voltages. (4 marks)

The fourth question (10 marks)	
1.	A 1250 KVA, 3.3 KV, 50 Hz, 300 rpm, three-phase star connected generator has 180 slots and 5 conductors per slot having single layer winding with full pitch coils and one circuit per phase. Determine the specific electrical and the specific magnetic loadings if the inner diameter of alternator is 2.2 m and axial length is 0.5 m. (5 marks)
2.	The lifting magnetic system shown in figure has a square cross-section of 25 cm^2. The coil has 300 turns and a resistance of 10 Ω. The air-gap is held at 5 mm and a dc source of 120 V is connected to the coil. Determine: 1. The flux density in the air gap. 2. The energy stored in the magnetic field. Neglect reluctance of the magnetic core and field fringing in the two air-gaps  (5 marks)

Good Luck and best wishes

Prof. Essam Eddin M. Rashad

Dr. Abd Elwahab hassan

Electrical Power and Machines Department

TANTA UNIVERSITY **Faculty Of Engineering**

Second MID-TERM EXAM 2013/2014

Course	**Energy Conversion** (EPM2106)	**Time**	**60 minutes**
Students	**2nd Year (Electrical Power and Machines)**	**Mark**	**30**

Answer ALL the following questions:

- ***Clarify your answer with the suitable sketches as you can.***
- ***Assume any missed data reasonably.***

The first question (10 marks)	
1.	For a closed-core magnetic circuit excited from an ac supply, show that the nonlinear characteristics of the core cause a distortion in the current waveform even if the flux waveform is sinusoidal. (3 mark)
2.	Explain the dot convention employed to determine the polarity of the mutually induced voltages. Then show how it can be determined experimentally. (4 mark)
3.	Discuss what is meant by magnetic flux leakage and fringing in the magnetic circuits; then show how to minimize them. (3 mark)

The second question (10 marks)	
1.	For a singly-excited rotating electromechanical energy converter, derive a relation for the developed torque in terms of co-energy. (3 mark)
2.	Using suitable clarifications of sufficient data, show the following: (4 marks) a) Solar cell characteristics b) Wind turbine characteristics c) Components of a photovoltaic generating system. d) A wind-energy-based generating system.
3.	For a doubly-excited electromechanical energy conversion device of cylindrical stator and rotor. Sketch the space variation of self and mutual inductances. (3 mark)

The third question (10 marks)	
1	An iron ring has a cross-section of 5 cm^2, and a mean diameter of 30 cm. An air-gap of 0.5 mm has been cut across the section. The ring is wound with a coil of 300 turns through which a current of 2 A is passed. If the total magnetic flux is 0.4 mWb, find the relative permeability of the iron. Neglect both magnetic leakage and fringing. (5 marks)
2	An electromagnet of 5 cm^2 cross section area and 1000 turns coil is used to control a relay. The magnet has an air gap length of g. Assume that the reluctance of the iron parts is negligible. For a range of g from 1 to 5 mm, it is required to develop a fixed force of 50 N. As a function of g, plot the required current and stored energy variations (5 marks)

Good Luck and best wishes

Prof. Essam Eddin M. Rashad
Dr. Abdelwahab hassan

Electrical Power and Machines Department

TANTA UNIVERSITY **Faculty Of Engineering**

Third MID-TERM EXAM 2012/2013

Course	**Energy Conversion** (EPM2106)	**Time**	**90 minutes**
Students	**2nd Year (Electrical Power and Machines)**	**Mark**	**40**

Answer ALL the following questions:

- ***Clarify your answer with the suitable sketches as you can.***
- ***Assume any missed data reasonably.***

The first question (10 marks)

Which of the following statements is correct? You can write down in your answer sheet the question number followed by either ✓ or X mark.

1.	Inductance of a coil increases with increase in magnetic reluctance of its core.
2.	For a linear magnetic system, coil inductance does not depend on its current
3.	Motional (speed) voltage increases with increasing supply frequency
4.	Mutual inductance between two coils depends on their self inductances
5.	For linear magnetic system stored energy equals co-energy.
6.	Direction of electromagnetic torque is to increase inductance
7.	Transformer voltage depends on coil inductance variation with position.
8.	The mutual inductance between two magnetically coupled coils must be lower than the smaller self inductance of each coils
9.	For doubly excited rotating system, it is necessary to have some saliency for possible electromechanical energy conversion.
10.	Distributed winding provides more sinusoidal mmf space variation

The second question (10 marks)

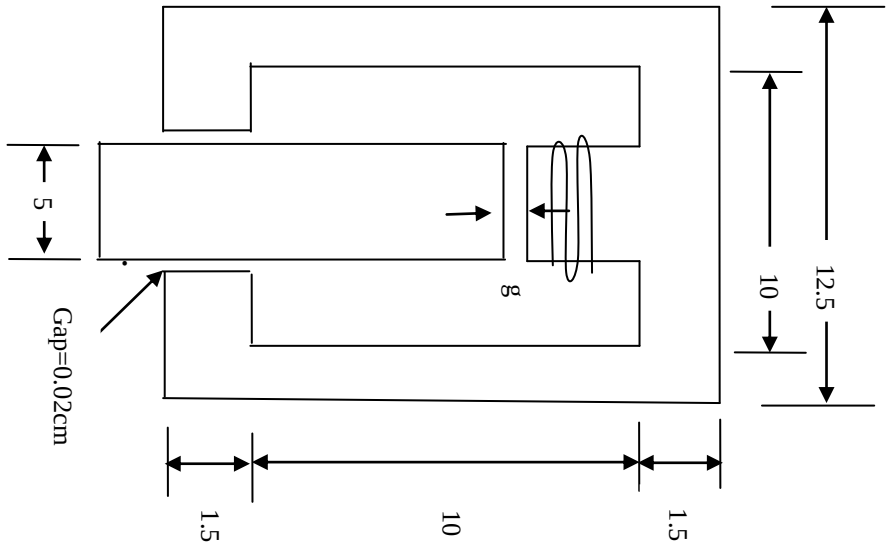
1. For a translational electro-mechanical energy conversion system, derive expressions for current, flux linkage and force in terms of stored energy and coenergy.

2. The device shown in the figure is a practical form of magnet. It is cylindrical about a vertical axis. The coil current carries a constant of 3.0 A. if the mmf in the iron is neglected.

   a- Compute the flux densities, in tesla, between the working faces of the center core and the plunger for gaps g=0.25, 0.5, and 1.25 cm.

   b- Compute the corresponding values of the coil inductance, in henries.

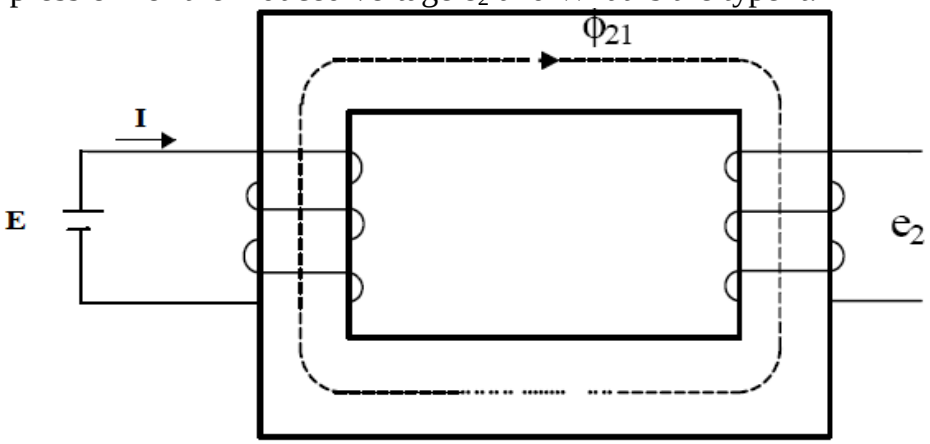
   c- Compute the energy stored in the magnetic field for each value of the air gap.



The third question (10 marks)

1	Show that the single-phase winding excited from an AC supply produces a pulsating MMF wave. Then show that this mmf can be viewed as the resultant of two rotating mmfs in opposite directions.
2	A doubly-excited rotating system with saliency associated with both the stator and the rotor. The stator self inductance has maximum and minimum values of 0.4 H and 0.2 H respectively, while maximum and minimum values of the rotor self inductance are 0.6 H and 0.4 H respectively. The maximum value of the mutual inductance between the two coils is 0.2 H. Find an expression for the torque acting on the rotor as a function of the angular position when stator current is 1 A and rotor current is 0.5 A. Sketch the variation of torque against rotor angular position.

The fourth question (10 marks)

1	Derive a general expression for the electromagnetic torque acting on the rotor of an AC single-excited device. The device has a cylindrical stator and rotor.
2	Derive an expression for the induced voltage e_2 and What is the type it. 

Good Luck and best wishes

Prof. Essam Eddin M. Rashad

Dr. Abdelwahab Hassan

Electrical Power and Machines Department

TANTA UNIVERSITY **Faculty Of Engineering**

MID-TERM EXAM 2012/2013

Course	**Energy Conversion** (EPM2106)	**Time**	**60 minutes**
Students	**2nd Year (Electrical Power and Machines)**	**Mark**	**25**

Answer ALL the following questions:

- ***Clarify your answer with the suitable sketches as you can.***
- ***Assume any missed data reasonably.***

The first question (6 marks)

Which of the following statements is correct? You can write down in your answer sheet the question number followed by either ✓ or X mark.

1.	Inductance of a coil increases with increase in magnetic reluctance of its core.
2.	For a linear magnetic system, coil inductance does not depend on its current
3.	Mutual inductance between two coils depends on their self inductances
4.	For linear magnetic system stored energy equals co-energy.
5.	Direction of electromagnetic torque is to increase inductance
6.	Transformer voltage depends on coil inductance variation with position.

The second question (12 marks)

1.	For a singly-excited rotating electromechanical energy converter, derive a relation for the developed torque in terms of co-energy. (3 mark)
2.	Derive a general expression for the electromagnetic torque acting on the rotor of an AC doubly-excited device. The device has a cylindrical stator and a salient-pole rotor. Then show how this device can be used as a synchronous machine. (6 mark)
	With the aid of BH curve of a permanent magnet material show: (3 marks) a) the effect of air gap length on the position of the operation point b) the point of maximum energy product

The third question (7 marks)

	An iron ring has a cross-section of 5 cm2, and a mean diameter of 30 cm. An air-gap of 0.5 mm has been cut across the section. The ring is wound with a coil of 300 turns through which a current of 2 A is passed. If the total magnetic flux is 0.4 mWb, find the relative permeability of the iron. Neglect both magnetic leakage and fringing. (3 marks)
	An electromagnet of 5 cm2 cross section area and 1000 turns coil is used to control a relay. The magnet has an air gap length of g. Assume that the reluctance of the iron parts is negligible. For a range of g from 1 to 5 mm, it is required to develop a fixed force of 50 N. As a function of g, plot the required current and stored energy variations (4 marks)

Good Luck and best wishes *Prof. Essam Eddin M. Rashad*

Electrical Power and Machines Department

TANTA UNIVERSITY — **Faculty Of Engineering**

MID-TERM EXAM 2014/2015

Course	**Energy Conversion** (EPM2106)	**Time**	**60 minutes**
Students	**2nd Year (Electrical Power and Machines)**	**Mark**	**30**

Answer ALL the following questions:

- *Clarify your answer with the suitable sketches as you can.*
- *Assume any missed data reasonably.*

The first question

1- Choose the correct answer/answers for the following statements. It is sufficient to write down the question number followed by your choice/choices in your answer sheet.

1. Higher magnetic permeability leads to
   (A) higher inductance
   (B) more flux leakage
   C) lower inductance
   (D) lower iron losses

2. Iron losses depend on
   A) electric supply frequency only
   B) area of hysteresis loop of the material only
   C) flux level only
   (D) all the of the above choices

3. Compared with magnetic materials, permanent magnetic material has higher values of
   A) magnetic field intensity (H)
   (B) relative permeability (μ_r)
   (C) flux density (B)
   D) current

4. Mutual inductance between two coils increases with increase of:
   A) angle between their axes
   B) their currents
   C) distance between them
   (D) none of the above choices

5. For mutually coupled coils, if currents are both entering at the dot-marked terminals, coil fluxes
   (A) are additive
   (B) increase
   C) are subtractive
   D) cancel each other

2- With the aid of BH curve of a permanent magnet material show:

a) the effect of air gap length on the position of the operation point

b) the point of maximum energy product

The second question

The core of the magnetic device as shown in figure is made of cast-iron and it is symmetrical both left and right arms. Find the current *I* that needed to establish flux of 30 μWb at the right arm of the core. $l_{ab} = l_{bc}$ $l_{cd} = 4$cm. l_g 0.5 cm. l_{da} 3cm and cross-section area of 1 cm^2.

The material having magnetic characteristics given by the following table.

B(T)	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8
H(AT/m)	300	500	750	1050	1600	2600	5000	10000

$\mathcal{R}_{hp}$

$l_{hp} = 0.5 cm$

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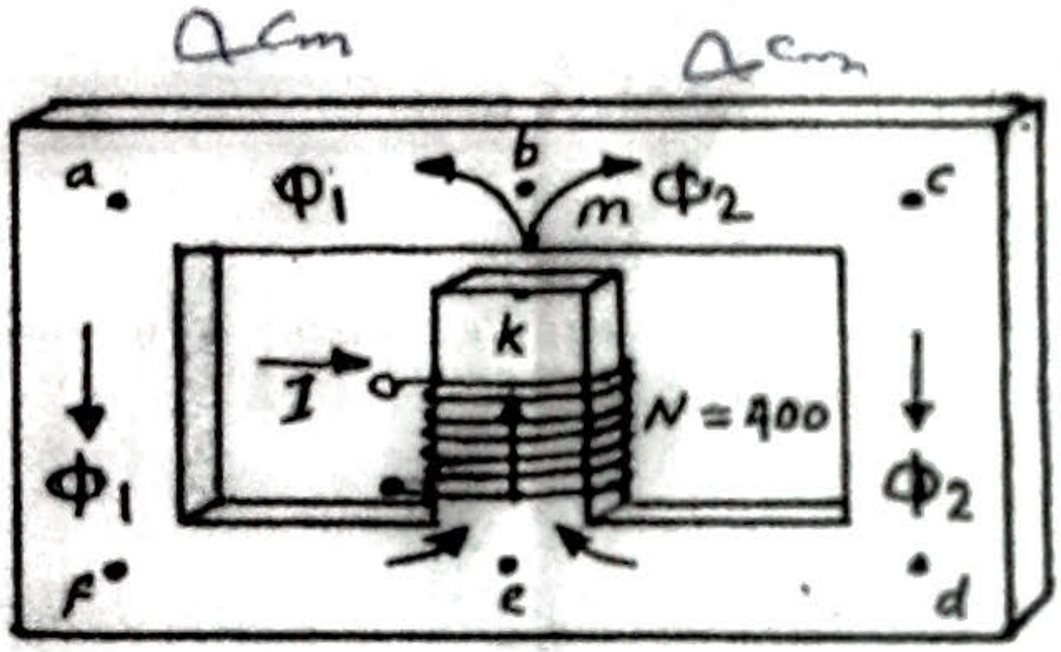
لذلك الفيل كامل
هيكون ٣hp



0.5 cm

0.5 cm

The third question

1.	For a singly-excited translational electromechanical energy converter. **derive** a relation for the developed torque in terms of stored energy.
2.	With the aids of current-flux linkage curves. **derive** how to determine energy converted into mechanical motion from a certain position to another.

The third question

A rotating electromagnetic system has a saliency in both stator and rotor. The rotor has no winding. The inductance varies sinusoidally with rotor position θ. The inductance is maximum at θ=zero. The stator current is AC of a peak of I_m and an angular frequency of ω. At steady-state, $\theta = \omega_m t + \delta$ where ω_m is rotor angular speed and t is time.

a) Sketch inductance against position variation.

b) Develop an expression for instantaneous torque acting on the rotor.

c) Find the ***condition*** for non-zero average torque and the ***corresponding average torque*** as a function of δ.

Good Luck and best wishes *Prof. Essam Eddin M. Rashad and Dr. Abd-El-wahab Hassn*

Electrical Power and Machines
Engineering *Department*

TANTA UNIVERSITY

Faculty of Engineering

MID-TERM EXAM 2015/2016

Course	**Energy Conversion** (EPM2106)	**Time**	**90 minutes**
Students	**2nd Year (Electrical Power and Machines)**	**Mark**	**30**

Answer ALL the following questions:

- *Clarify your answer with the suitable sketches as you can.*
- *Assume any missed data reasonably.*

The first question (5 marks)

Choose the correct answer/answers for the following statements. It is sufficient to write down the question number followed by your choice/choices in your answer sheet:

1. Linear magnetic characteristics leads to:
   A) distorted magnetizing current
   B) higher power loss
   C) higher inductance
   D) constant inductance
2. For mutually coupled coils, if currents are both entering at the dot-marked terminals, coil fluxes
   A) cancel each other
   B) increase
   C) are subtractive
   D) are additive
3. The stored energy in magnetically coupled coils *does not* depend on
   A) Coupling coefficient between coils.
   B) direction of currents
   C) angle between coils
   D) direction of motion
4. To obtain higher voltages, solar cells are connected
   A) in parallel
   B) in series-parallel combination
   C) with a battery of higher voltage
   D) in series
5. For a singly-dc-excited electromechanical system, very slow motion means approximately
   A) constant flux linkage operation
   B) constant mmf operation
   C) constant current operation
   D) constant flux operation

The second question (5 marks)

Which of the following statements is correct? You can write down in your answer sheet the question number followed by either √ or X mark.

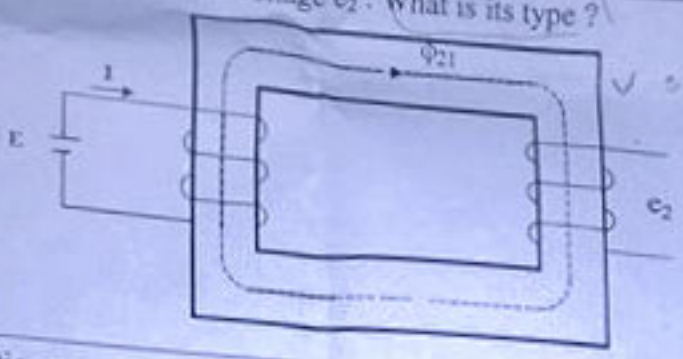
1. Core losses depend on area of hysteresis loop of the magnetic material.
2. To reduced eddy current losses, magnetic circuit is made of isolated laminations.
3. Inductance of a coil increases with decrease in magnetic reluctance of its core.
4. For a linear magnetic system, coil inductance does not depend on its current
5. The wind speed is most effective quantity on the available mechanical energy at shaft of a wind turbine

Please Turn Over

The third question (10 marks)

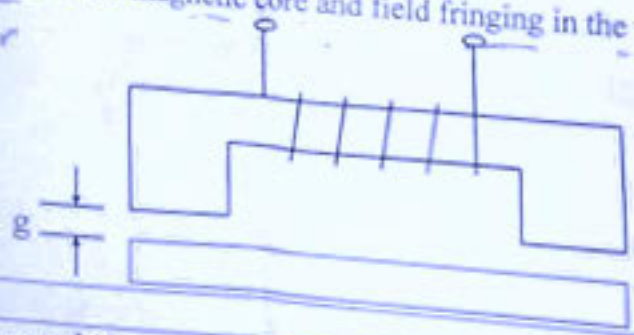
1. With the aid of BH curve of a permanent magnet material show
   a) the effect of air gap length on the position of the operation point
   b) the point of maximum energy product

2. Derive an expression for the induced voltage e_2 . What is its type ?



3. The lifting magnetic system shown in figure has a square cross-section of 25 cm^2. The coil has 300 turns and a resistance of 10 Ω. The air-gap is held at 5 mm and a dc source of 120 V is connected to the coil. Determine:
   1. The flux density in the air gap.
   2. The energy stored in the magnetic field.

   Neglect reluctance of the magnetic core and field fringing in the two air-gaps



The fourth question (10 marks)

1. Sketch with all necessary details and explanation, the space variation of self and mutual inductances of a rotating system of salient stator and cylindrical rotor.

2. With *derived* suitable relations, show how to obtain both input electrical energy and change in stored energy in a fixed system. Then show to obtain the energy converted into mechanical form when moved from a position to another

3. Define **co-energy**. Then **derive** how it can be used to obtain **the force** developed in a singly-excited electromechanical energy translational converter

Good Luck and best wishes

Prof. Essam Eddin M. Rashad and Dr. Abd Elwahab Hassan